Study on the Influence of Underground Filling Body on Flotation Index of Beneficiation in Gold Mine

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Abstract. The processing capacity of a gold concentrator in Shandong mine is 10000 t/d, and the production process of one-stage grinding + one roughing, two sweeping and one finishing is adopted. The grinding fineness is 50%-55% of -200 mesh content, the flotation concentration is 40%-45%, and the dosage of butyl xanthate used as collector is 120 (g/t). The amount of QX-3 used as foaming agent is 40 (g/t), and the field flotation recovery rate is 93.74%. Because the mixing of tailings backfill into raw ore will cause the deterioration of flotation index, this study aims to find out the influence of tailings backfill in gold ore on flotation index, and put forward reasonable suggestions, so as to provide technical guidance for the mixing of tailings backfill in the subsequent production of gold mine.

1 Introduction
At present, except for a few rich ores rich in useful minerals, the vast majority of ores extracted from mines are lean ores containing a large number of gangue. These lean ores have low content of useful components and complex mineral composition. In order to develop and utilize low-grade lean ores more economically, ores must be sorted or enriched so as to discard most gangue and make the content of useful minerals meet the requirements of smelting [1-2]. In the enrichment process, the most important process is the separation process, but in the actual production process, there are many factors affecting the selection of other, such as: tailings filling body, grinding concentration, grinding fineness, pulp pH value, reagent system, aeration and stirring, flotation time, water quality and temperature [3-4].

In recent years, with the increase of underground filling amount in gold mines, tailings backfill body is often mixed into gold-bearing raw ore [5-7]. After entering the beneficiation process, this part of tailings backfill body often causes serious impact on the production index, such as the decrease of floatability of natural gold and gold-bearing mineral pyrite, the decrease of flotation foam and the increase of viscosity, and the virtual high fineness of grinding products. The recovery rate of gold and the stability of flotation production system were seriously affected.

2 Conditional test

2.1 Multi-element analysis of samples
Multi-element analysis was carried out on the mixed test sample, and the analysis results were shown in Table 1.

2.2 Grinding time and product fineness condition test
Under the condition of grinding concentration of 67%, the grinding time of 2, 3, 4, 5, 6, 7, 8, 9 min was carried out to determine the content of -200 mesh in the product. The test results are shown in Figure 1.

![Fig. 1. Relation between grinding time and product size change.](image)
As can be seen from Figure 1, with the increase of grinding time, the content of -200 mesh in grinding products gradually increases. The subsequent test adopts interpolation method to determine the grinding fineness corresponding to grinding time.

2.3 Grinding fineness condition test
According to the relation curve between grinding time and product particle size, the grinding time corresponding to different product particle size was determined. The flotation test was carried out at the

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Table 1. Results of multi-element analysis of test samples.

<table>
<thead>
<tr>
<th>Sample name</th>
<th>Grade</th>
<th>Grade</th>
<th>Grade</th>
<th>Grade</th>
<th>Grade</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw ore sample</td>
<td>1.88 Au/(g·t⁻¹)</td>
<td>1.2 Ag/(g·t⁻¹)</td>
<td>0.01 Cu/%</td>
<td>0.01 Pb/%</td>
<td>0.01 Zn/%</td>
<td>0.73 S/%</td>
</tr>
</tbody>
</table>

flotation concentration of 42%, dosage of butyl xanthate 120 (g/t), dosage of 2# oil 40 (g/t), and content of -200 mesh in grinding products were 45%, 50%, 55%, 60% and 65%, respectively [8]. The test process is shown in Figure 2, and the test results are shown in Figure 3.

2.4 Flotation concentration condition test

When the fineness of the grinding product is 60% mesh content, the amount of collector is 120 (g/t), and the amount of foaming agent is 40 (g/t), the flotation concentration is 30%, 34%, 38%, 42%, and 46% respectively. The test process is shown in Figure 4, and the test results are shown in Figure 5.

It can be seen that from Figure 4 and Figure 5: (1) With the gradual increase of flotation concentration, the concentrate rate presents an increasing trend. When the flotation concentration reaches 42%, the concentrate yield basically remains stable. (2) With the gradual increase of flotation concentration, the concentrate grade showed a downward trend. When the flotation concentration reached 42%, the concentrate grade basically remained stable. (3) With the gradual increase of flotation concentration, the recovery rate showed an increasing trend. When the flotation concentration reached 42%, the recovery rate basically remained stable. Considering factors such as concentrate rate, concentrate grade and recovery rate, the flotation concentration of 42% was adopted as the optimal condition.
3 Closed circuit test

3.1 Closed circuit test of raw ore (without filling body added)

After determining the optimal flotation process parameters, closed-circuit test was carried out on raw ore (without filling body added). The process flow was shown in Figure 6, and the test results were shown in Figure 7.

![Figure 6](image)

**Fig. 6.** Schematic diagram of the closed circuit test process of raw ore without filling body added.

![Figure 7](image)

**Fig. 7.** Flow chart of quantity and quality of raw ore (without filling body added).

3.2 Closed circuit test of raw ore (with 5% of filling body added)

After determining the optimal flotation process parameters, closed-circuit test was carried out on raw ore (with 5% of filling body added). The process flow was shown in Figure 8 and the test results were shown in Figure 9.

![Figure 8](image)

**Fig. 8.** Schematic diagram of the closed circuit test process of raw ore with 5% of filling body added.

![Figure 9](image)

**Fig. 9.** Flow chart of quantity and quality of raw ore (without filling body added).

3.3 Comparison of closed-circuit flotation results

Considering the factors such as fine mineral rate, concentrate grade, tailings grade and recovery rate [10], when the filling body addition amount reaches 5%, the recovery rate decreases by nearly 1.75% compared with that without filling body addition, which has a great impact. The experimental results of closed-circuit flotation are shown in Table 2.

<table>
<thead>
<tr>
<th>Raw ore((Filling body)</th>
<th>Productivity (%)</th>
<th>Concentrate Grade Au(g/t)</th>
<th>Tailings Grade Au(g/t)</th>
<th>Recovery Au (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>2.49</td>
<td>70.35</td>
<td>0.12</td>
<td>93.74</td>
</tr>
<tr>
<td>5%</td>
<td>2.33</td>
<td>72.31</td>
<td>0.15</td>
<td>91.99</td>
</tr>
</tbody>
</table>
4 Conclusion

Based on the flotation index deterioration caused by the mixing of underground filling body into raw ore in gold mine, and the recovery rate decreased by 1.75%, the following conclusions are drawn:

(1) Strengthen downhole site management. Increase the strength of the backfill body to avoid the crushing and muddling of the backfill into the raw ore in the mining process, thus entering the flotation production process and worsening the flotation index.

(2) Increase the manual selection of beneficiation. For the filling body entering the crushing process of the concentrator, it is suggested to encourage the field operators to carry out hand selection through labor competition and other means, so as to further reduce the mass entering the grinding flotation system.

(3) Explore the waste disposal process of filling body. Due to the great difference between the backfill body and the ore physical properties, the massive backfill body can be thrown out in advance by throwing waste before crushing to reduce the influence on the flotation index.

(4) Research index improvement methods. For the backfill that has entered into the beneficiation production system, it is suggested to carry out flotation test, increase the recovery rate of beneficiation by adding activator and so on, and reduce the influence of filling on flotation index.

References


